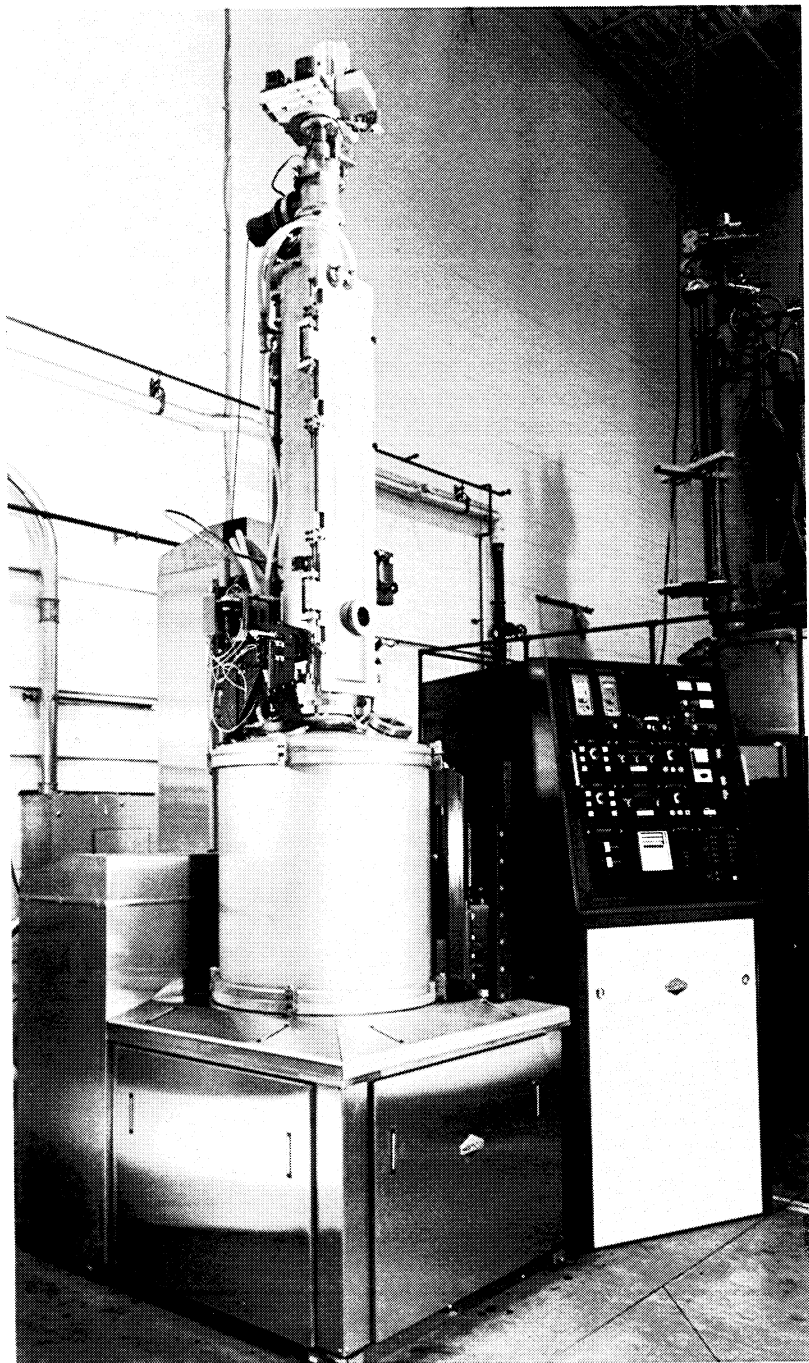


Crystal Furnace



The system pictured is a Hamco CG6000 crystal growing furnace, manufactured by Kayex Corporation, a unit of General Signal, Rochester, New York and sold to industrial firms that grow crystals for use in semiconductors and solar cells. A key element in its operation is a "melt recharging" technique developed under contract to Jet Propulsion Laboratory (JPL).

In the latter 1970s, as part of the National Photovoltaic Program jointly sponsored by NASA and the Department of Energy, JPL was exploring ways to cut the cost of silicon solar cells, thin wafers produced by "growing" cylindrical silicon crystals in a furnace and slicing them. Normally, the crystal growing crucible had to be cooled after a run, then reheated and refilled with silicon. JPL accepted a Kayex proposal for an experimental program aimed at improving crucible productivity by serially growing several crystals from the same crucible through use of a melt recharger. This consisted of a hopper lowered into the hot zone of the crucible, making it possible to add raw silicon to an operating crucible. By eliminating the cooldown and heatup periods, the melt recharging method reduces the cost of crystals.

Kayex successfully accomplished a key development essential to melt recharging, an isolation valve that permitted lowering the hopper into the crucible without disturbing the inert gas atmosphere or lowering the melting temperature. Once the recharge method had been demonstrated to be effective, Kayex advanced the technology to allow growth of larger crystals and increase crucible capacity to 60 kilograms, from about 20 kilograms in an existing CG2000 Kayex system. This was done by redesigning the CG2000 and scaling up its parts. The Kayex/JPL prototype thus developed performed well over a monitoring period of several months.

Kayex engineers and designers then used the operational results and measurements from the JPL grower as the basis for designing the advanced CG6000 which, in production use, proved to outperform the earlier CG2000 by as much as 50 percent. The CG6000 has become the company's major product.